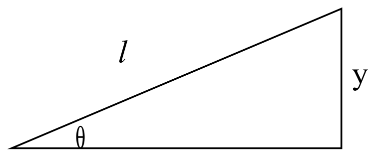
Chapter 7 Problem 38 †



Given
$\theta = 30°$
$m = 16,000\ kg$
$v_i = 110\ km/h = 30.6\ m/s$

Solution
Find the distance along the ramp that the truck travelled.

The initial kinetic energy is $\frac{1}{2}mv^2$ and let the initial potential energy be zero. The increase in potential energy is mgy and the final kinetic energy is zero since the truck will come to a halt. Using the conservation of mechanical energy we get

$$K_i + U_i = K_f + U_f$$

$$\frac{1}{2}mv^2 + 0 = 0 + mgy$$
$$\frac{1}{2}mv^2 = mgy \tag{1}$$

Since we want the distance along the ramp, we can replace y with the following trigonometric relationship $\sin\theta = \frac{y}{l}$, therefore,

$$y = l\sin\theta \tag{2}$$

Substituting equation (2) into (1) gives

$$\frac{1}{2}mv^2 = mgl\sin\theta$$

Solving for l gives

$$l = \frac{mv^2}{2mg\sin\theta} = \frac{v^2}{2g\sin\theta}$$

$$l = \frac{(30.6\ m/s)^2}{2(9.80\ m/s^2)\sin(30°)} = 95.5\ m$$

†Problem from Essential University Physics, Wolfson